ANALYSING THE INTERFACE OF BUSINESS INTELLIGENCE AND ENTERPRISE RESOURCE PLANNING

[1] Papri Ray, [2] Dr T.A. Ashok Kumar

[1] PhD Scholar- Garden City University and Asst Professor- Christ (Deemed to be) University
[2] Dean of Sciences and Vice Principal, Garden City University

Abstract **—**In today's world organizations have been investing huge sums of money and resources in order to implement ERP and Business Intelligence systems. In the competitive world which is out there today, BI and ERP have become important and key strategic tools which have a direct impact on the success and the failure of implementation of any project. However, there is a lack of attention which has been given for the proper integration of ERP and Business Intelligence. This paper involves systems, models of BI, ERP implementation, as well as other reporting tools and data miming. In the past many studies have acknowledged the increasing effect of Business Intelligence Systems (BIS) positioning in supporting important business decision-making processes. The main aim of this research is to conduct a comparative case study in order to evaluate the important reasons that drive the organizations to upgrade and implement and upgrade BIS and ERP, with respect to the of potential relationships between them.

Index Terms – Enterprise Resource Planning (ERP), Business Intelligence, Decision Support System(DSS)

1. INTRODUCTION

Enterprise resource planning (ERP) comes with integrated business intelligence (BI) modules that help organizations to provide active reporting, providing operators with exactly what they want to see, when they want to see it. Generally, Business Intelligence (BI) can be defined as the conversion of raw data into meaningful data depending upon past, present and future business operations and performance. ERP is a technological and managerial enchantment in organizations and SMEs that help information circulation, and inhibit business decision making processes **(Antoniadis et al, 2015).** BI activities were done manually in the past, from gathering data from multiple sources, manipulating the data and giving a static report. This effort was done by different functional areas within the organization and this would cost countless hours of reporting. BI thus helps in ERP, to get all data and timeless reporting techniques.

Over the past few decades, integrated Enterprise Resource Planning (ERP) applications have brought a new revolution in the way of delivering operation information. ERP systems today have a highly integrated database that means data from multiple ERP modules is taken and then it is integrated into one database. Many vendors are having BI tools to access their data modules directly. BI Tools (OLAP, Data mining and Query) are used to create more consistent and knowledge centric data reports.

2. LITERATURE REVIEW

2.1. Enterprise Resource Planning

Over the past few decades, integrated Enterprise Resource Planning (ERP) applications have brought a new revolution in the way of delivering operational information **(David et al, 2005).**After the evolution of scientific management, organizations are pushing themselves towards collecting the right information and building communication tools like ERP systems **(Ghazanfari et al, 2009).**Enterprise Resource Planning is dependent on the implementation of 4 levels including the Materials planning, Capacity planning, Materials management and Shop-floor control **(Tenhiala et al, 2015)**. Content analysis is the technique which was used for systematic examination of data **(Hawking, et al, 2010). Wixom and Watson (2001)** studied around 111 organizations and they found that data and system quality mainly impacted data warehouse success with system quality being four times as important as that of data quality**(Hawking et al, 2010).** ERP systems today have a highly integrated database that means data from multiple ERP modules data is taken and then it is integrated into one database **(David et al, 2005).**

2.2. The ERP catalyst

The aim of ERP systems is to integrate systems not only across the departments but also across the whole enterprise **(Lujic et al, 2005).** The central element of the ERP system is that the database is unique and has a capacity of storing big volumes of data in an organized way **(Lupu et al, 2007).** ERP is like a catalyst, for all firms operating in competitive and globalized economy **(Antoniadis et al, 2015).** This makes it very important to

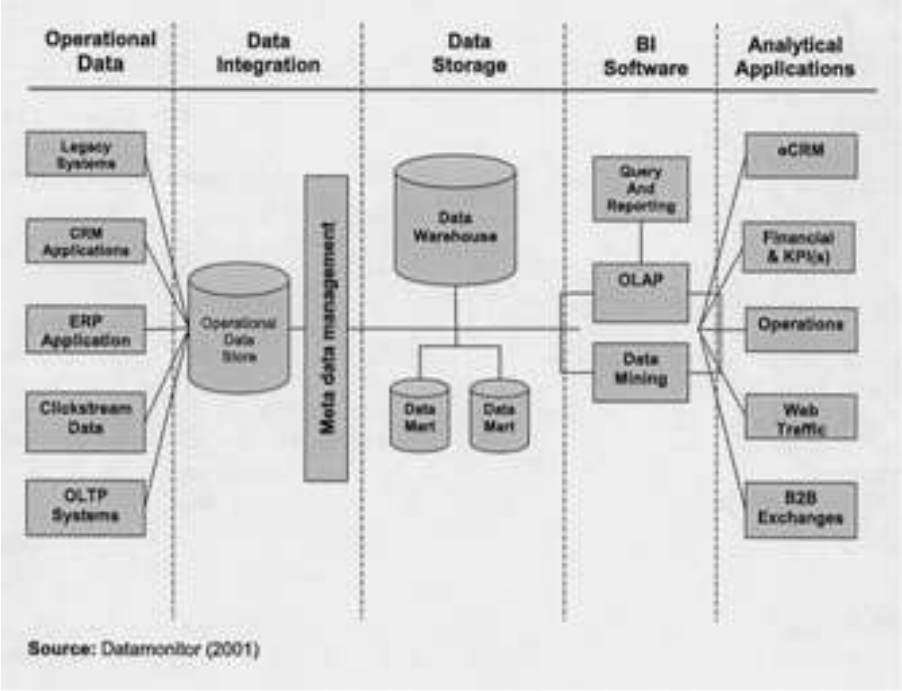
understand and study these ERP systems **(Ghazanfari et al, 2009**). Undoubtedly, the ERP improves the operational efficiency and effectiveness by facilitating and speeding business processes **(Ghazanfari et al, 2009).** Initially ERP automated materials management on the factory floor and then in the second wave it started leveraging Business Intelligence in implementation **(Ward, et al 2006).**

2.3. Integration of ERP and BI

Introduction of Business Intelligence to ERP has helped to implement the critical phases of operations and meet the customer demands to a great extent **(Ward, et al, 2006).** Business Intelligence (BI), as an enabler of ERP, will influence on flexible manufacturing systems (FMS) **(Tenhiala et al, 2015).** Business Intelligence is developed on top of ERP, it has the advantage acquiring simplified data which can be drawn from a particular source **(Nofa et al, 2016).**Visibility of information for rapid decision making and streamlining the process is the main advantage as the accessibility of reliable data from across the enterprise helps to analyze the bottlenecks **(Ward, et al, 2006).** The perceived value of Business Intelligence in ERP and the ability to learn it are the key determinants for its acceptance and successful implementation **(Antoniadis et al, 2015).** Business Intelligence in ERP has enabled the supplier to have greater access to information and understanding the customer demand and reduce finished goods inventory **(Ward, et al, 2006).** Business Intelligence in ERP helped to get right in formation in a timely manner and thus it has a positive impact on business operations **(Lupu et al, 2007).**

2.4. BI and ERP Benefits

The integration of Business Intelligence with ERP has helped organizations to integrate all the technologies and it offers direct access to the system from anywhere **(Lupu et al, 2007).** When it comes to the relationship between ERP and BI, the overall investment in Business Intelligence is essential in order to release the full potential of data stored in an ERP system **(Caserio, 2011).** The system starts when BI outputs are needed in order to obtain an effective decisional support, which in turn makes sure that the coding of data is defined and particular parameters are which in turn help in customizing the ERP, making it fully capable **(Caserio, 2011).** Quality of decisions made is directly dependant on the quality of data produced by an ERP system **(Caserio, 2011).**The best way is to evaluate the solutions for the gaps in implementation of meeting the requirements of managers **(Ghazanfari et al, 2009).** The end user involvement is very important to developing BI solutions as the requirement and scope are generally set by the users as they are the final users of the data **(Lupu et al, 2007).** Powerful BI tool can generate different views from available data **(David et al, 2005).**



Scaled data mart or data warehouse can provide rich and timely information into the BI tools **(Rasmussen et al., 2002)**. BI tools play a crucial role in enhancing the quality of decision making by using the data collected from ERP systems **(David et al, 2005).** BI systems have added intelligence into the ERP data collected.BI and ERP integration has greatly improved the IT performance and decision making capability inside the organization **(David et al, 2005).** BI systems are highly reliant on ERP systems functionality and vast amount of data that it can generate **(Hawking, et al, 2010).**

2.5. Problems in Implementation

The main problem in ERP implementation is many companies underestimate the impact and requirements to implement the systems **(Hawking, et al, 2010).** Another issue which the companies faced is integration of data and the processes from heterogeneous systems **(Deliotte, 1999).** The lack

of integration had hindered business process execution to a great extent and effective decision making **(Davenport, 1998).** Small and medium-sized enterprises (SMEs) are usually skeptical on using business intelligence or ERP systems in the organization **(Antoniadis et al, 2015).** The main dilemma arises due to cost incurring in implementing and training the employees **(Antoniadis et al, 2015).** The desire for quick result will not give effective results, thus longer periods are required, to which managers do not oblige **(Antoniadis et al, 2015).**

Many vendors are having BI tools to access their data modules directly **(David et al, 2005).** BI Tools (OLAP, Data mining and Query) are used to create more consistent and knowledge centric data reports **(David et al, 2005).**Crisis in business force, at the least, pose an option to the SMEs to implement SMEs **(Antoniadis et al, 2015).** Companies are now widely moving towards the implementation of BI in ERP because of accessibility and data cleansing techniques are properly implemented with this integration **(Lupu et al, 2007).** Nowadays Business intelligence (BI) tools provide optimal decision making, analyzing, and controlling of operations in enterprise systems like ERP and mainly refer to strong decision making methods used in OLAP, reporting and data analysis, such as improving internal processes, costs reduction and revenue increase **(Mehardad et al, 2016).**

3. Data Analysis from Researched Secondary Sources

Table 1. Results of perceptions of managers concerning Business Intelligence capabilities of ERP systems.

Sl no.	Possibility of Business Intelligence	Average	Median	S.D.	Range	D (significance p.)
1	Group services and tools groupware	3.97	4	0.706	2	D(37)=0.260. p=0.00
2	Possibilities of collaborative decision Making	3.68	4	0.541	2	D(37)=0.370. p=0.00
3	Clustering of problems	4.03	4	0.875	3	D(37)=0.220. p=0.00
4	Optimization techniques	4.45	5	0.768	3	D(37)=0.343. p=0.00
5	Import/Export data from/to other systems	4.48	5	0.769	2	D(37)=0.394. p=0.00
6	Simulation models	3.55	3	0.810	3	D(37)=0.267. p=0.00
7	Simulation / risk assessment	3.74	4	1.094	4	D(37)=0.238. p=0.00
8	Treasury management tools (capital. producers. loans)	3.90	4	1.044	4	D(37)=0.247. p=0.00
9	Economic management tools (Financial Accounting)	4.42	4	0.620	2	D(37)=0.309. p=0.00
10	Investment Management Tools	3.39	4	1.174	4	D(37)=0.215. p=0.00
11	Cost audit tools	4.19	5	1.138	4	D(37)=0.309. p=0.00
12	Property management tools	3.35	3	1.082	4	D(37)=0.215. p=0.00

13	Graphic representations	3.90	4	1.012	4	D(37)=0.309. p=0.00
14	OLAP Possibilities (Multi-dimensional analysis)	4.39	5	0.715	2	D(37)=0.210. p=0.00
15	Aggregated results tools	4.68	5	0.702	2	D(37)=0.377. p=0.00
16	Entrepreneurial references (enterprise reporting)	4.42	5	0.848	3	D(37)=0.320. p=0.00
17	Data Extraction (data mining)	4.19	4	0.873	4	D(37)=0.484. p=0.00
18	Dynamic user interface (Dashboard)	4.03	4	0.836	2	D(37)=0.334. p=0.00
19	Decision making methods. using fuzzy Logic	3.74	4	1.032	4	D(37)=0.283. p=0.00
20	Decision making analysis with multi criteria	3.87	4	1.056	4	D(37)=0.231. p=0.00
21	Data ware houses	4.13	4	0.846	3	D(37)=0.212. p=0.00
22	Applications on mobiles (mobile application). tablets	4.03	4	0.912	3	D(37)=0.247. p=0.00
23	Cloud applications systems (Web based)	3.61	4	0.989	4	D(37)=0.278. p=0.00
Total averages		***3.99***		***0.508***		

Source:ERP Framework for FlexibleManufacturing Systems Using Business Intelligence (BI) Tools ***(Mehrdad et al, 2016)***

Interpretation - The capabilities of business intelligence that are perceived most important by managers are the aggregated results tools whose average is 4.68 followed by importing/exporting data which is 4.48 as for the economic management/accounting tools the average was 4.42 whereas the least important are property management tools whose average is 3.35 followed by investment analysis tools with the average being 3.39. The average of different possible capabilities of business intelligence perceived by managers is 3.99 where the standard deviation is 0.508.

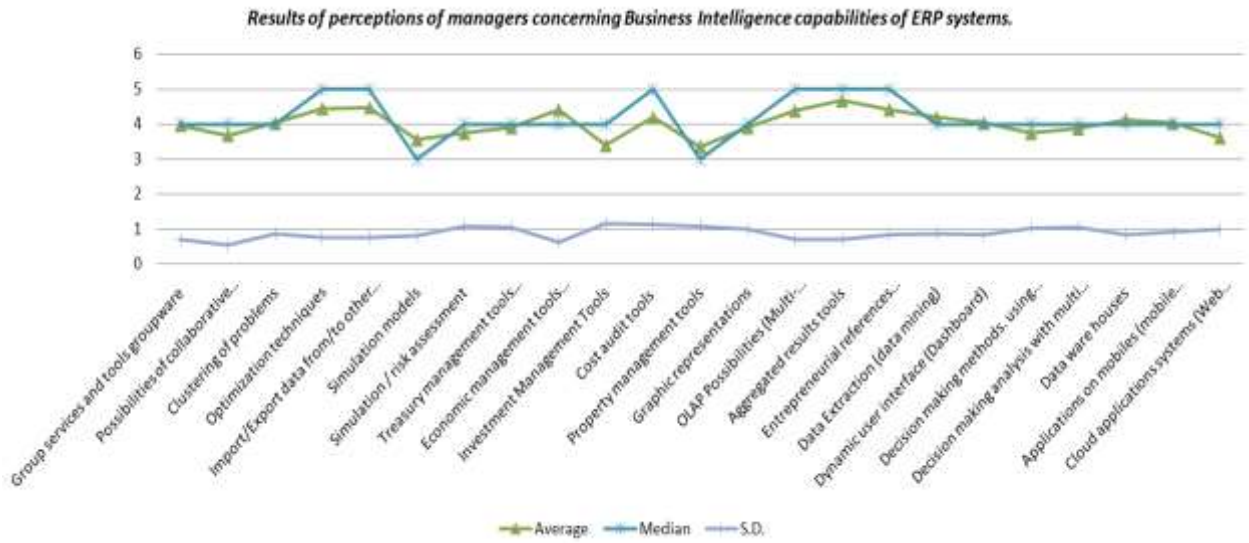


Table 2. Factors affecting the successful of Business intelligence as an enabler of ERP system based on Tenhiala et al.'s Model (2015).

S.no	Factors	Average	Median	S.D.	D (sig.p.)
1	Demand information using integrated of BI and ERP in flexible manufacturing system	3.04	4	0.769	D(37)=0.486, p=0.00
2	Product specifications using integrated of BI and ERP in flexible manufacturing system	4.35	5	0.810	D(37)=0.345, p=0.00
3	Bills of materials using integrated of BI and ERP in flexible manufacturing system	3.98	5	0.844	D(37)=0.388, p=0.00
4	Cost centers using integrated of BI and ERP in flexible manufacturing system	3.75	5	0.883	D(37)=0.454, p=0.00
5	Routings/recipes using integrated of BI and ERP in flexible manufacturing system	3.67	4	1.071	D(37)=0.455, p=0.00
6	Work centers and resources using integrated of BI and ERP in flexible manufacturing system	3.91	5	1.032	D(37)=0.473, p=0.00
7	Shift schedules using integrated of BI and ERP in flexible manufacturing system	4.16	5	0.819	D(37)=0.398, p=0.00
8	Vendor data using integrated of BI and ERP in flexible manufacturing system	3.96	4	0.833	D(37)=0.404, p=0.00
9	Goods receipts using integrated of BI and ERP in flexible manufacturing system	4.62	4	0.952	D(37)=0.412, p=0.00
10	Goods issues using integrated of BI and ERP in flexible manufacturing system	4.82	4	0.877	D(37)=0.370, p=0.00
11	Accounts payable using integrated of BI and ERP in flexible manufacturing system	4.33	5	0.912	D(37)=0.439, p=0.00
12	General ledger using integrated of BI and ERP in flexible manufacturing system	3.73	4	0.708	D(37)=0.481, p=0.00
13	Order confirmations using integrated of BI and ERP in flexible manufacturing system	4.18	4	0.769	D(37)=0.373, p=0.00
14	Maintenance and repair using integrated of BI and ERP in flexible manufacturing system	4.72	5	1.049	D(37)=0.492, p=0.00
15	Staffing decisions using integrated of BI and ERP in flexible manufacturing system	4.49	5	0.97	D(37)=0.436, p=0.00
Total Average:		***4.11***		***0.88***	

Source:Tenhiala et al.'s Model (2015).

II Interpretation - The above table talks about 15 business intelligence capabilities of ERP systems in flexible manufacturing systems surveyed in questionnaire. The average value of the total 15 variable came out as **4.11** and the standard deviation resulted to be **0.88** after taking out the average of each standard deviation variable. The Cronbach value resulted to be **0.933** as per the 15 variables which were taken into consideration and the Cronbach alpha lies in the range when $\alpha \geq 0.9$ which implies the internal consistency is excellent. In the Kolmogorov-Smirnov test the null hypothesis is rejected as the p value is 0 which implies that the sample is not normally distributed.

Table 3: Results of perceptions of managers concerning Business Intelligence capabilities of ERP systems with respect to factors affecting the successful Business intelligence (as an enabler of ERP systems)

Table 3. Results of perceptions of managers concerning Business Intelligence capabilities of ERP systems in flexible manufacturing systems			
S no.	**Correlations**	**Spearman coefficient**	**Significance p.**
1	The relationship between "process improvement of materials planning", and "using integrated of BI and ERP in flexible manufacturing system".	**-0.023**	**0.892**
2	The relationship between "process improvement of capacity planning", and "using integrated of BI and ERP in flexible manufacturing system".	**-0.018**	**0.903**
3	The relationship between "process improvement of materials management", and "using integrated of BIand ERP in flexible manufacturing system".	**-0.021**	**0.901**
4	The relationship between "process improvement of Shop-floor control", and "using integrated of BI and ERP in flexible manufacturing system".	**-0.019**	**0.897**

Source:ERP Framework for FlexibleManufacturing Systems Using Business Intelligence (BI) Tools ***(Mehrdad et al, 2016)***

Interpretation - This table talks about the link between the benefits implementing an ERP system and Business Intelligence capabilities in flexible manufacturing system.Furthermore, the correlations between ERP system implementation and their Business Intelligence capabilities, with the years of ERP usage are also investigated, using the Spearman coefficient in IranKhodro Company. The value of Spearman's coefficient signifies that business intelligence plays a vital role on the fabrication of flexible manufacturing systems. The ideal Spearmans coefficient lies between the range of 1 and -1. The ideal p-value should be greater than or equal to 0.05 and as per the findings of the table the p value is more than 0.05 which implies that null hypothesis is accepted.

BI tools play a crucial role in enhancing the quality of decision making by using the data collected from ERP systems. The integration of Business Intelligence with ERP has helped organizations to integrate all the technologies and it offers direct access to the system from anywhere. Business Intelligence in ERP helped the organizations to focus on analysis of data to a greater extent as it can improve organization's performance rather than focus on collection of data. Companies are now widely moving towards the implementation of BI in ERP because of accessibility and data cleansing techniques are properly implemented with this integration. Business Intelligence plays a major role in Data Warehousing and Guesswork elimination as ERP forms the perfect synergy for taking better decisions using BI techniques.

III. CONCLUSIONS

Due to the usefulness of the new Business Intelligence tools and ERP's capability to combine all the available key data into one podium, ERP and BI work together in order to give managers the power they require to make important, data-based decisions. Through this paper we have noted that BI enhances an ERP system as it efficiently gathers stores, analyzes, and gives access to data in order to help the users make better organizational decisions due to the decision support systems and online investigative processing. However an efficient approach to BI must pay close attention to the structure of data, because ultimately they are the root for most of the decisional support systems. Even if the Business Intelligence system can lead to an adaptable and a more customizable decision support system, it is actually always dependant on the pre-fixed structure of data. When it comes to up gradation of a BI solution, it consists of the feedback on its functionalities which is given by users and a few vendors. Through this interface, the up gradation involves both the final outputs and the data structure.

Lastly though, people from different departments in an organization need a range of ways to use information, and they require the analysis tools which are easy to learn and use. Business Intelligence makes sure that networked information flows really freely through the organization, providing employees with a medium though which they can communicate and collaborate.

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